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^{r} revised
x suppressed to meet the confidentiality requirements of the *Statistics Act*
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F too unreliable to be published
* significantly different from reference category ($p < 0.05$)

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Abstract

Background

Infant mortality and stillbirth rates among Aboriginal people are higher than in the rest of Canada, but little is known on the perinatal health status of First Nations people living on reserves. This study examines stillbirth and infant mortality rates among Aboriginal people in Quebec, notably, First Nations people living on reserves, and compares these rates with those of the province's non-Aboriginal population.

Data and methods

Data on live births and stillbirths in Quebec from 1989 to 2008 were extracted from Statistics Canada's Infant Birth-Death Linked File. Postal codes were used to identify births and stillbirths on First Nations reserves, in the Cree and Naskapi communities (not on reserves), and in Inuit communities. Associations between type of community and mortality were measured using logistic regression models.

Results

Aboriginal people had a higher stillbirth rate than non-Aboriginal people in Quebec, but this difference was not significant after adjusting for socio-demographic characteristics (mothers' age and education, community size and isolation). Neonatal mortality was also higher among the Inuit. Post-neonatal mortality was higher among Aboriginal people, and was unrelated to differences in the mothers' age and education or to community size and isolation. Adjusted odds ratios (95% confidence intervals) for post-neonatal mortality on reserves, in the Cree and Naskapi communities, and in Inuit communities were, respectively, 1.57 (1.16 - 2.12), 3.01 (2.14 - 4.24) and 4.29 (3.09 - 5.97).

Interpretation

Stillbirth and infant mortality are higher among Aboriginal people than non-Aboriginal people in Quebec. The differences in post-neonatal mortality are particularly pronounced.

Keywords

Databases, data linkage, First Nations, Inuit, vital statistics

Authors

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Several studies have shown that infant mortality and stillbirth rates are higher among First Nations and Inuit people than in the rest of the Canadian population.[1-4] In these studies, Aboriginal people were identified on the basis of residence in an area with a large percentage of Aboriginal people, census data, self-identification on birth records (British Columbia), or mother tongue of the mother (Quebec).

However, these studies do not distinguish First Nations people who live on reserves. It is useful to determine the health status of First Nations people living on reserves, whose socio-economic conditions are often more precarious than those of the rest of the population.[5] In addition, health services on reserves are managed under a separate health system. Health Canada provides funding for prevention and health promotion as well as for home and community care services for people living on reserves. Health Canada is also responsible for primary health care on remote reserves, whereas the responsibility is provincial for the rest of the population. Determining the health status of the on-reserve population would facilitate planning of health programs. Identifying members of this population based on language has the disadvantage of excluding Aboriginal people who adopted English or French as their home language.

This analysis was undertaken to measure stillbirth and infant mortality rates of Aboriginal people in Quebec, in particular, First Nations people living on reserves, and compares them with rates for non-Aboriginal people in the province.

Data and methods

Data on live births and stillbirths in Quebec from 1989 to 2008 were extracted from Statistics Canada's Infant Birth-Death Linked File, which was created by linking the death records of infants younger than one year of age with birth records.[6] At the time of this study, 2008 was the most recent year for which record linkage was completed.

Births that took place in Aboriginal communities were identified by postal code. The validity of the postal codes was verified using Statistics Canada's Postal Code Conversion File Plus (PCCF+).[7] Only records containing a valid postal

code for residential buildings (97.3% of the total) were retained.

Using the PCCF+ program, a list of postal codes corresponding to First Nations Reserves, Cree or Naskapi communities and Inuit communities was established by type of census subdivision. The Cree and Naskapi were processed separately from other First Nations people because they differ in two respects:

- Under the 1975 *James Bay and Northern Quebec Agreement*, Quebec's Cree and Naskapi communities are no longer reserves within the meaning of the *Indian Act*. Health Canada does not fund primary care for this population, although it provides services and programs supplementing health services provided by the province.
- Compensation paid by the Quebec government for use of hydroelectric resources located on their territory has changed their socio-economic status.

Because 11 First Nations reserves in Quebec share postal codes with a neighbouring non-Aboriginal community, these Aboriginal communities cannot be identified using postal codes. These communities include: Gesgapegiag, Timiskaming, Eagle Village, Ekuanitshit, Natashquan, Essipit, Matimekush-Lac John, Winneway, Kanesatake and Pakuashipi. Therefore, two separate variables were created to classify Aboriginal communities: one including shared postal codes with Aboriginal communities, and another including shared postal codes with non-Aboriginal communities.

The following outcomes were analyzed:

- Stillbirths of fetuses weighing 500 grams or more (after exclusion of pregnancy terminations);
- Neonatal deaths (0 to 27 days after birth);
- Post-neonatal deaths (28 to 364 days after birth);
- Infant deaths (sum of neonatal and post-neonatal deaths).

Table 1
Characteristics of births, stillbirths and infant deaths, Quebec, 1989 to 2008

	Live births[1]		Stillbirths		Infant deaths	
Characteristic	**Number**	**%**	**Number**	**%**	**Number**	**%**
Total	1,620,270		5,560		8,100	
Type of community (shared postal codes included with First Nations)						
First Nations reserve	16,240	1.0	90	1.6	100	1.2
Cree or Naskapi	6,860	0.4	30	0.5	80	1.0
Inuit	5,350	0.3	30	0.5	100	1.2
Non-Aboriginal	1,591,820	98.2	5,400	97.1	7,820	96.5
Type of community (shared postal codes included with non-Aboriginal)						
First Nations reserve	12,170	0.8	70	1.3	80	1.0
Cree or Naskapi	6,860	0.4	30	0.5	80	1.0
Inuit	5,350	0.3	30	0.5	100	1.2
Non-Aboriginal	1,595,890	98.5	5,420	97.5	7,850	96.9
Mothers' age						
19 or younger	65,140	4.0	300	5.4	560	6.9
20 to 34	1,358,790	83.9	4,290	77.2	6,400	79.0
35 or older	196,000	12.1	950	17.1	1,140	14.1
Mothers' education						
9 years or less	98,580	6.1	400	7.2	750	9.3
10 to 12 years	510,680	31.5	1,520	27.3	2,780	34.3
13 years or more	831,080	51.3	2,160	38.8	3,330	41.1
Unknown	179,940	11.1	1,470	26.4	1,240	15.3
Birth						
Single	1,580,670	97.6	5,180	93.2	7,010	86.5
Multiple	39,600	2.4	380	6.8	1,090	13.5
North-South gradient						
North	10,690	0.7	60	1.1	160	2.0
Northern transition	9,700	0.6	40	0.7	70	0.9
Southern transition	133,630	8.2	440	7.9	750	9.3
South	1,466,250	90.5	5,010	90.1	7,130	88.0
Size of community and metropolitan influence						
1,500,000 or more	813,900	50.2	2,830	50.9	3,860	47.7
500,000 to 1,499,999	203,150	12.5	630	11.3	950	11.7
100,000 to 499,999	98,850	6.1	310	5.6	550	6.8
10,000 to 99,999	184,120	11.4	640	11.5	900	11.1
10,000 or less (strong metropolitan influence)	86,400	5.3	300	5.4	430	5.3
10,000 or less (moderate metropolitan influence)	142,450	8.8	480	8.6	760	9.4
10,000 or less (weak metropolitan influence)	91,410	5.6	360	6.5	640	7.9
Period						
1989 to 1993	444,280	27.4	1,320	23.7	2,540	31.4
1994 to 1998	408,010	25.2	1,550	27.9	2,100	25.9
1999 to 2003	364,220	22.5	1,270	22.8	1,620	20.0
2004 to 2008	403,760	24.9	1,410	25.4	1,840	22.7

[1] includes infant deaths
Note: Numbers are rounded to nearest 10.
Source: Infant Birth-Death Linked File, 1989 to 2008.

The following variables, obtained from birth records, were included in the analysis:

- Mothers' age (10 to 19, 20 to 34, and 35 or older), because infant mortality[8] and stillbirth rates[9] are higher for children of mothers younger than 20 and 35 or older;
- Mothers' years of education (9 or less, 10 to 12, and 13 or more), because less education is associated with higher stillbirth and infant mortality rates[10];
- Multiple births, a risk factor for stillbirth and infant mortality[11];
- Year of birth, grouped by five-year periods, to account for the decline in infant mortality during the 1990s and 2000s.[8]

Two variables derived from the PCCF+ were included in the analyses, because they are associated with stillbirth and infant mortality rates in Canada[12,13]:

- community size and the influence of metropolitan zones (a measure of rural isolation), combined into one variable;
- north-south gradient.

Mortality rates for the different outcomes were calculated. Associations between the outcomes and risk factors (Aboriginal status, mothers' age and education, multiple birth, north-south gradient, size and isolation of communities) were examined. Unadjusted and adjusted odds ratios (ORs) and 95% confidence intervals (CIs) were calculated using logistic regression models.

In accordance with Statistics Canada's rules on disclosure, counts were rounded to the nearest 10, and rates were calculated based on rounded values. However, odds ratios were calculated based on the exact numbers.

Results

A total of 1,620,270 live births and 5,560 stillbirths were included in the analysis (Table 1). Of the live births, 8,100 were linked to death records. The number of births on First Nations reserves, including reserves with a shared postal code, was estimated at 16,240. When births occurring on reserves with shared postal codes were excluded, the number declined to 12,170. The numbers of births in Cree and Naskapi communities and Inuit communities were 6,860 and 5,350, respectively. Aboriginal mothers were substantially younger and had less education than non-Aboriginal mothers (Table 2).

For most outcomes, rates and odds ratios were not substantially different if communities with shared postal codes were included as Aboriginal, compared with including shared postal codes with reserves. Consequently, only the results based on the former approach are shown in Tables 2 to 6. Post-neonatal mortality was the only outcome for which the approach used changed the results noticeably.

Stillbirth rates for Aboriginal people living on First Nations reserves, in Cree and Naskapi communities and in Inuit communities were significantly higher than for non-Aboriginal people, but differences were not statistically significant after adjustment for maternal characteristics, multiple birth and geographic isolation (Table 3).

Infant mortality was higher for all Aboriginal groups. However, on First Nations reserves, the difference disappeared after adjustment for maternal characteristics, multiple birth and geographic isolation (Table 4).

Neonatal mortality was significantly higher for Inuit than for non-Aboriginal people, but no significant difference in neonatal mortality emerged between First Nations people and non-Aboriginal people (Table 5).

Finally, post-neonatal mortality was significantly higher for all Aboriginal groups than for non-Aboriginal people. Excess mortality remained significant

Table 2
Distribution of socio-demographic characteristics of births, by type of community, Quebec, 1989 to 2008

	Type of community							
	First Nations reserve		Cree or Naskapi		Inuit		Non-Aboriginal	
Characteristic	Number	%	Number	%	Number	%	Number	%
Mothers' age								
19 or younger	2,880	17.6	1,470	21.3	1,260	23.5	59,830	3.7
20 to 35	12,190	74.6	4,930	71.6	3,840	71.5	1,342,130	84.0
35 or older	1,260	7.7	490	7.1	270	5.0	194,930	12.2
Mothers' education								
9 years or less	3,730	22.8	2,010	29.1	1,340	24.9	91,890	5.8
10 to 12 years	5,050	30.9	2,930	42.5	1,790	33.3	502,440	31.5
13 years or more	3,920	24.0	1,150	16.7	800	14.9	827,380	51.8
Unknown	3,630	22.2	810	11.7	1,450	27.0	175,520	11.0
Birth								
Single	15,950	97.7	6,740	97.8	5,270	98.0	1,557,880	97.5
Multiple	380	2.3	150	2.2	110	2.0	39,340	2.5
North-South gradient								
North	520	3.2	4,250	61.7	5,380	100.0	610	0.0
Northern transition	1,180	7.2	2,630	38.2	0	0.0	5,940	0.4
Southern transition	7,110	43.5	10	0.1	0	0.0	126,950	7.9
South	7,530	46.1	0	0.0	0	0.0	1,463,730	91.6
Size of community and metropolitan influence								
1,500,000 or more	2,720	16.7	0	0.0	0	0.0	813,970	51.0
500,000 to 1,499,999	370	2.3	0	0.0	0	0.0	203,420	12.7
100,000 to 499,999	140	0.9	0	0.0	0	0.0	99,020	6.2
10,000 to 99,999	4,860	29.8	0	0.0	0	0.0	179,870	11.3
10,000 or less (strong metropolitan influence)	40	0.2	0	0.0	0	0.0	86,840	5.4
10,000 or less (moderate metropolitan influence)	110	0.7	0	0.0	0	0.0	142,670	8.9
10 000 or less (weak metropolitan influence)	8,080	49.5	6,890	100.0	5,380	100.0	71,440	4.5

Notes: Values shown are number of births (including stillbirths). Numbers are rounded to nearest 10.
Source: Infant Birth-Death Linked File, 1989 to 2008.

Table 3
Stillbirths in Aboriginal and non-Aboriginal communities, Quebec, 1989 to 2008

Type of community	Rate per 1,000 births[2]	Unadjusted odds ratio	95% confidence interval		Adjusted odds ratio[3]	95% confidence interval	
			from	to		from	to
First Nations reserve	5.5	1.60*	1.29	1.97	1.22	0.98	1.52
Cree or Naskapi	4.4	1.46*	1.04	2.05	1.26	0.88	1.80
Inuit	5.6	1.76*	1.25	2.50	1.25	0.86	1.81
Non-Aboriginal[1]	3.4	...	...	...	...	...	...

* significantly different from reference category ($p < 0.05$)
[1] reference category
[2] denominator includes live births and stillbirths
[3] adjusted for mothers' age and education; community size and metropolitan influence; and period
... not applicable
Notes: Rates were calculated based on numbers rounded to nearest 10. Odds ratios were calculated based on unrounded numbers.
Source: Infant Birth-Death Linked File, 1989 to 2008.

Table 4
Infant mortality (0 to 364 days after birth) in Aboriginal and non-Aboriginal communities, Quebec, 1989 to 2008

Type of community	Rate per 1,000 births[2]	Unadjusted odds ratio	95% confidence interval		Adjusted odds ratio[3]	95% confidence interval	
			from	to		from	to
First Nations reserve	6.2	1.31*	1.08	1.59	1.00	0.82	1.23
Cree or Naskapi	11.7	2.24*	1.78	2.82	1.63*	1.28	2.10
Inuit	18.7	3.86*	3.16	4.71	2.62*	2.10	3.28
Non-Aboriginal[1]	4.9	...	...	...	...	...	...

* significantly different from reference category ($p < 0.05$)
[1] reference category
[2] denominator includes live births and stillbirths
[3] adjusted for mothers' age and education; community size and metropolitan influence; and period
... not applicable
Notes: Rates were calculated based on numbers rounded to nearest 10. Odds ratios were calculated based on unrounded numbers.
Source: Infant Birth-Death Linked File, 1989 to 2008.

Table 5
Neonatal mortality (0 to 27 days after birth) in Aboriginal and non-Aboriginal communities, Quebec, 1989 to 2008

Type of community	Rate per 1,000 births[2]	Unadjusted odds ratio	95% confidence interval		Adjusted odds ratio[3]	95% confidence interval	
			from	to		from	to
First Nations reserve	3.7	0.95	0.73	1.24	0.77	0.59	1.01
Cree or Naskapi	4.4	1.21	0.84	1.73	0.97	0.66	1.41
Inuit	9.3	2.55*	1.92	3.38	1.86*	1.37	2.54
Non-Aboriginal[1]	3.6	...	...	...	...	...	...

* significantly different from reference category ($p < 0.05$)
[1] reference category
[2] denominator includes live births and stillbirths
[3] adjusted for mothers' age and education; community size and metropolitan influence; and period
... not applicable
Notes: Rates were calculated based on numbers rounded to nearest 10. Odds ratios were calculated based on unrounded numbers.
Source: Infant Birth-Death Linked File, 1989 to 2008.

after adjustment (Table 6). The difference between First Nations reserves and non-Aboriginal communities was greater if shared postal codes were included with non-Aboriginal communities (adjusted OR: 1.79; 95% CI: 1.29 – 2.47) than if they were included with reserves (adjusted OR: 1.57; 95% CI: 1.16 – 2.13).

Discussion

The differences in perinatal health between Aboriginal and non-Aboriginal people in Quebec are already known.[1-4] This study sheds new light by describing the perinatal health status of First Nations people living on reserves and in Cree and Naskapi communities, and comparing them with non-Aboriginal people.

The significantly higher rates of stillbirth, neonatal mortality and post-neonatal mortality before adjustment (for mothers' age and education, size and isolation of community and period) indicate that Aboriginal communities are disadvantaged in relation to the rest of the province's population. The significantly higher rates of post-neonatal mortality among Aboriginal people, and of stillbirth among Inuit, even after adjustment, show that regardless of differences in mothers' age and education, a gap persists. Some behaviours associated with stillbirth or infant mortality are also associated with mothers' age and education, including smoking during pregnancy, which is a risk factor, and breastfeeding, a protective factor.[14]

First Nations people living on reserves had a higher stillbirth rate but a lower neonatal mortality rate than non-Aboriginal people. It is possible that the apparently low neonatal mortality among First Nations people reflects under-registration of non-viable newborns. This phenomenon has been observed in Ontario[15] and might exist in some health care institutions in other provinces.

Table 6
Post-neonatal mortality (28 to 364 days after birth) in Aboriginal and non-Aboriginal communities, Quebec, 1989 to 2008

Type of community	Rate per 1,000 neonatal survivors[‡]	Unadjusted odds ratio	95% confidence interval		Adjusted odds ratio[§]	95% confidence interval	
			from	to		from	to
First Nations reserve	3.1	2.29*	1.72	3.05	1.57*	1.16	2.13
Cree or Naskapi	7.3	5.11*	3.80	6.87	3.01*	2.14	4.24
Inuit	9.4	7.48*	5.66	9.89	4.29*	3.09	5.97
Non-Aboriginal[†]	1.3	...	...	...	...	...	...

* significantly different from reference category ($p < 0.05$)
† reference category
‡ infants who survived 28 days
§ adjusted for mothers' age and education; multiple birth; community size and metropolitan influence; and period
... not applicable
Notes: Rates were calculated based on numbers rounded to nearest 10. Odds ratios were calcualted based on unrounded numbers.
Source: Infant Birth-Death Linked File, 1989 to 2008.

Excess mortality associated with stillbirths in Aboriginal communities was attenuated and ceased to be significant after adjustment for age, mother's education and the size and isolation of communities, suggesting that the excess was partly due to these factors.

Post-neonatal mortality was also higher among Aboriginal people than in the rest of the population, and the differences remained statistically significant after adjustment. In fact, post-neonatal mortality is the outcome for which the gap between Aboriginal and non-Aboriginal people was greatest. Other studies have found that differences between socio-economic classes were greater for post-neonatal mortality than for stillbirths and neonatal mortality.[8,16] The small number of events (approximately 100 infant deaths for on-reserve populations, 60 for Cree and Naskapi, and 110 for Inuit) made it difficult to examine specific causes of mortality.

In the absence of data on behaviours and other individual risk and protective factors, it was impossible to identify possible causes of the differences observed in this study. However, several known risk factors are more prevalent among Aboriginal people than in the rest of the population. For example, Inuit and First Nations women in Quebec smoke more than do other women in the province[17,18]; the rate of macosomia (birth weight exceeding 4,000 grams) is higher for First Nations people than for non-Aboriginal people[13,19]; and the prematurity rate is higher for Inuit.[20] Furthermore, the unfavourable socio-economic conditions that prevail in a number of communities may be associated with other risk factors that are not captured in vital statistics and health surveys.

Limitations

The main limitation of this study is the use of postal codes to identify Aboriginal people, which does not precisely distinguish between Aboriginal and non-Aboriginal people living in the same community. Other limitations are the lack of information on stillbirths under 500 grams (for which registration is not required), possible under-registration of neonatal deaths, and the small number of events with the associated need to round numbers, which made it impossible to study mortality rates by cause of death. Finally, use of vital statistics data limited the analysis to data collected during birth and death registration; behavioural factors such as breastfeeding and smoking could not be taken into account.

What is already known on this subject?

- Infant mortality and stillbirth rates are higher among Aboriginal people than among the rest of the Canadian population.

What does this study add?

- In Quebec, the Inuit, the Cree and the Naskapi (First Nations in the north of the province) and the First Nations people living on reserves in the south of the province have stillbirth and post-neonatal mortality rates exceeding those of the rest of the province.
- The excess neonatal mortality is independent of mothers' age and education and the size and isolation of communities.
- Post-neonatal mortality on First Nations reserves in southern Quebec is greater than that of the province's non-Aboriginal population, including non-Aboriginal communities that are isolated and socio-economically disadvantaged.

Conclusion

Stillbirth and post-neonatal mortality are higher on First Nations reserves, in Cree and Naskapi communities, and in Inuit communities than in the rest of the Quebec population. Neonatal mortality is also higher among Inuit. In the case of post-neonatal mortality, the difference between Aboriginal and non-Aboriginal people persisted after adjustment for socio-demographic differences (mothers' age and education), which indicates that other mechanisms may contribute to the observed difference. ■

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